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Dolomitic or Calcitic Lime

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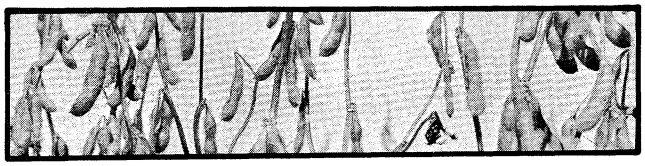
AGRONOMY GUIDE



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Lime

Dolomitic or Calcitic Lime

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Dolomitic limestone contains both magnesium and calcium whereas calcitic limestone contains very little magnesium. A representative sample of dolomitic limestone sold in Indiana may contain 21 per cent calcium and 11 per cent magnesium A common calcitic limestone may contain 40 per cent calcium and 0.2 per cent magnesium. The amount and ratio of calcium and magnesium in the soil will be affected by the type of limestone you use.

Importance of the Calcium-Magnesium Ratio

The calcium and magnesium available for plant uptake in Indiana soils are held as exchangeable cations (individual calcium and magnesium ions) on the soil clay and organic matter particles. The capacity of the clay and organic matter to hold these exchangeable calcium and magnesium cations is termed the cation exchange capacity. The exchange capacity is usually given in terms of milliequivalents per 100 grams, and this may vary from 2 to 30 or 40 milliequivalents per 100 grams on mineral soils. The magnesium may occupy 5 to 30 per cent of the possible sites with calcium, potassium and hydrogen occupying most of the remainder. There will always be more calcium than magnesium present even with additions of dolomitic limestone.

Several people have conducted research to determine the ratio of calcium and magnesium that will give the best plant growth. These researchers have found that the ratio can be varied from equal amounts of calcium and magnesium to 98 per cent calcium and 2 per cent magnesium without affecting crop yield as long as the total amount of exchangeable magnesium in the soil is not too low. The per cent of a cation such as calcium on the soil exchange is called the per cent saturation with that cation.

The results of research at Illinois are summarized:

> "Results from the experiment with four soils seemed to indicate that the percentage saturation of the soil with magnesium has little influence on the amount of magnesium removed, but that the amount of exchangeable magnesium present appeared to be the important factor."

Table 1 contains data on the effect of per cent saturation on yield and composition of soybeans of a greenhouse experiment on Muscatine silt loam soil.

Purdue agronomists have conducted many experiments to determine the relation on crop yield of magnesium application and magnesium level in the soil. Twenty-eight field experiments were conducted with alfalfa. Thirteen field experiments were conducted with soybeans, and two field experiments were conducted with corn. In all cases, the magnesium-treated and untreated plots received the equivalent of 200 pounds P_2O_5 and 200

Table 1. Effect of per cent saturation on yield and composition of soybeans a/

Saturation with			Composition of plant material	
Calcium	Magnesium	Yield per pot	Calcium	Magnesium
%	%	grams	%	%
71	1	4.4	0.89	0.27
72	3	5.6	0.56	0.28
68	6	5.5	0.56	0.29
53	13	5.1	0.66	0.28
34	34	5.1	0.44	0.47
12	50	5.5	0.43	0.35

a/ Results were obtained from a greenhouse experiment on Muscatine silt loam soil.

pounds of K_2O per acre. Of the 28 experiments on alfalfa, only two gave an indication of yield response to magnesium application, and none showed a significant yield decrease. On most plots 60 pounds of magnesium was applied per acre. The per cent saturation with magnesium varied from 4.4 to 27.0 and averaged 12.1. The pounds of available magnesium in the soil varied from 38 pounds to 377 pounds. One location showing a 9 per cent increase in yield had the highest magnesium content and a 10.7 per cent saturation of the exchange capacity with magnesium. It is doubtful that this was a true response. The second location on Coloma sand had a magnesium content of 65 pounds and a 6.6 per cent saturation of the exchange capacity. Yields were increased 13 per cent.

No significant change in soybean yields resulted from application of 45 pounds of magnesium per acre at 13 locations. The amount of magnesium in these soils varied from 89 to 382 pounds per acre and the per cent magnesium saturation varied from 9.5 to 23.6 and averaged 14.4.

On a corn experiment on Newton fine sandy loam, magnesium sulfate was applied to give 72 pounds of magnesium per acre (Table 2). Six tons of finely ground (+100 mesh) limestone was used. All plots received adequate amounts of nitrogen, phosphorus and potassium. The average increase of 6.5 bushels to the limestone application was significant statistically. The increase from magnesium was not significant. This soil contained 370 pounds of magnesium and had 9 per cent magnesium saturation of the exchange capacity. It had a pH of 4.7 and 970 pounds of calcium per acre.

A second corn experiment on Tracy sandy loam showed that neither calcitic limestone nor magnesium affected the corn yield significantly. This soil contained 288 pounds of magnesium per acre and the exchange capacity was 19 per cent saturated with magnesium.

The results of these field and greenhouse experiments indicate that we are not likely to reduce yield by applying too much magnesium in the form of dolomitic limestone. They also indicate that we are not likely to get a response in yield to magnesium unless our soil is very low in available magnesium.

In recent years some soil testing services have been determining the amounts of available calcium and magnesium in the soil and then recommending liming with either calitic or dolomitic lime to adjust these two nutrients to a certain ratio. For example, some laboratories make recommendations on the basis of the per cent saturation of the soil exchange capacity. These laboratories frequently recommend that the soil exchange capacity contain 75 per cent calcium, 10 per cent magnesium, and 2.5 per cent potassium.

Table 2. The results of a corn experiment on Newton fine sandy loam

Treatment	Yield	Increase
	bushels per acre	
None	72.0	
Magnesium sulfate	74.6	2.6
Calcitic limestone	79.1	7.1
Magnesium sulfate + calcite limestone	80.5	8.5

This means that, if a soil has an exchange capacity of 15.0, the pounds per acre of these nutrients these laboratories believe should be in the soil are 4500 pounds calcium, 360 pounds magnesium, and 300 pounds potassium.

Many Indiana soils with an exchange capacity of 15 may contain 500 or more pounds of magnesium even though they still need liming. This is more magnesium than these laboratories believe should be present. Because of this, they advise the farmer to go to the added expense and haul calcitic limestone from great distances instead of using the dolomitic limestone he has available locally.

There is no research justification for going to the added expense to obtain a definite calcium-magnesium ratio in the soil. Research indicates that plant yield or quality is not appreciably affected over a wide range of calcium-magnesium ratios in the soil.

The plant root system selectively absorbs the nutrients. It is able to get the relative proportion of nutrients it needs even though the ratio in the soil fluctuates widely. It is fortunate for us that the plant has this capability.

Interpreting Soil Tests for Calcium and Magnesium

The calcium and magnesium in the soil must move to the plant root to be absorbed, or the root must move to these nutrients. The root system of field crops occupies 2 per cent or less of the open spaces between soil particles. Therefore, it grows to 2 per cent or less of the amount shown in pounds per acre on a soil test. If we have 1000 pounds calcium and 300 pounds magnesium, the root grows to 20 pounds of calcium and 6 pounds of magnesium. This is not enough for a 150 bushel corn crop that requires 25-30 pounds each of calcium and magnesium. These two nutrients are carried to the root by a second method. Plants absorb about 250 pounds of water for every pound of plant dry matter produced. This water flowing to the root contains calcium and magnesium and carries these nutrients up to the root surface. We found that soil solutions of Indiana soils average about 25 pounds of each of calcium and magnesium per million pounds of water where soils are limed. A crop uses about 3 million pounds of water per acre. Thus, on the average well-limed soil, more calcium and magnesium is carried to the root surface than the crop needs. We have shown that calcium accumulates outside the root. The amount in the soil water varies with many soil properties, such as organic matter content, soluble salts, kind of clays and amount of calcium and magnesium on the exchange sites.

These uptake processes were discovered at Purdue during recent years. Considerable developmental research will have to be done before the results of this basic research can be used routinely for liming recomendations. Hence, we are not making all the measurements needed to use this concept.

What to Do

Whether to use calcitic or dolomitic limestone depends on several factors:

(1) If you know only the pH and lime requirement, use dolomitic limestone at least once in every four times limestone is applied.

(2) If the magnesium level is 100 pounds per acre or more, apply calcitic or dolomitic lime.

(3) If the magnesium level is below 100 pounds per acre, it may be advisable to use limes containing some magnesium.

(4) Don't worry about getting too much magnesium on the soil.

Determination of Lime Requirement

The determination of calcium, magnesium and exchange capacity make it pos sible to calculate the lime needed. However, most state laboratories measure the amount of hydrogen that needs to be displaced and in this way arrive at the lime requirement. They get the same result as when the lime requirement is calculated from the exchange capacity and available calcium and magnesium.

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